Charge Controllers

A charge controller is an electronic voltage regulator used in systems with battery banks to keep the voltage to the battery within acceptable limits. The charge controller automatically tapers, stops, or diverts power when batteries become fully charged. Charge controller capacities range from 4 to 80 A and multiple charge controllers can be used in parallel for larger systems. Some charge controllers offer additional features, like charge status display, datalogging, automatic battery equalization charging, generator starting, and even lighting controls.

The simplest charge controllers disconnect the power source when the battery reaches a set voltage, and turn it on when a low voltage set point is reached. **Pulse Width Modulated (PWM)** charge controllers turn on and off very rapidly, maintaining the batteries at full charge voltage, which results in quicker and more complete battery charging. **Maximum Power Point Tracking (MPPT)** charge controllers optimize the voltage of the PV array to maximize total power output then convert that to the correct voltage to charge the battery. This process significantly increases the power from a solar array, particularly in low temperatures when battery voltage is significantly below the PV array voltage. Most MPPT charge controllers work with higher array voltages, enabling the use of larger solar modules, which can be more economical on a cost per watt basis. A higher voltage solar array also minimizes the required wire size between the array and the charge controller. While more expensive than PWM controllers, MPPT charge controllers can boost system performance by up to 30% and are well worth the extra cost in many types of installations.

MPPT Charge Controllers

The table below shows recommended maximum nameplate PV array sizes. The sizes shown can be exceeded by up to 20% without damaging the controller, but some "clipping" of potential peak current may occur under cool, clear conditions. While exceeding these wattages may reduce power harvest at peak times of the day, the total daily amp-hours delivered to the battery bank will be greater because the larger array will produce more power in less than peak conditions such as mornings, afternoons, and in hazy or cloudy weather.

MPPT Charge Controllers at a Glance

Model	Max output current	Maximum recommended PV array size			Max PV array voltage (V_{OC})	Item code
		12 VDC	24 VDC	48 VDC		
OutBack FLEXmax 60	60 A	750 W	1,500 W	3,000 W	150 VDC	**020-02017**
OutBack FLEXmax 80	80 A	1,000 W	2,000 W	4,000 W	150 VDC	**020-02020**
MidNite Classic 150	96 A at 12 VDC[1] 94 A at 24 VDC[1] 86 A at 48 VDC[1]	1,200 W	2,350 W	4,300 W	150 VDC[2]	**020-02405**
MidNite Classic 200	79 A at 12 VDC[1] 78 A at 24 VDC[1] 76 A at 48 VDC[1]	1,000 W	1,950 W	3,800 W	200 VDC[2]	**020-02407**
MidNite Classic 250	61 A at 12 VDC[1] 62 A at 24 VDC[1] 55 A at 48 VDC[1]	750 W	1,550 W	2,750 W	250 VDC[2]	**020-02409**
Schneider XWMPPT60-150	60 A	750 W	1,550 W	3,000 W	150 VDC	**020-08040**
Schneider XWMPPT80-600	80 A	--	2,000 W	4,000 W	600 VDC	**020-08048**
Morningstar SS-15MPPT	15 A	200 W	400 W	--	75 VDC	**020-01261**
Morningstar TS-MPPT-45	45 A	600 W	1,200 W	2,400 W	150 VDC	**020-01109**
Morningstar TS-MPPT-60	60 A	800 W	1,600 W	3,200 W	150 VDC	**020-01110**
Blue Sky SB2000E	25 A	310 W	--	--	30 VDC	**020-03122**
Blue Sky SB2512i	25 A	310 W	--	--	35 VDC	**020-03123**
Blue Sky SB50L	50 A	625 W	1,250 W	--	57 VDC	**020-03140**
Blue Sky SB1524iX	20 A at 12 VDC 15 A at 24 VDC	250 W	375 W	--	57 VDC	**020-03118**
Blue Sky SB3024iL	40 A at 12 VDC 30 A at 24 VDC	500 W	750 W	--	57 VDC	**020-03158**
Blue Sky SB3048L	30 A	--	750 W	1,500 W	140 VDC	**020-03128**

[1]Amps shown are reduced at the higher end of the controller's array voltage range. Consult product manual for details.
[2]Absolute max open circuit voltage is the value listed, plus the nominal battery voltage.

OutBack

FLEXmax MPPT Charge Controllers

The **FLEXmax** MPPT software algorithm is both continuous and active, increasing PV array power yield up to 30% compared to non-MPPT controllers. FLEXmax charge controllers can operate at their maximum rated current in ambient temperatures as high as 104°F (40°C) and can be used with battery systems from 12 to 60 VDC with PV open-circuit voltage as high as 150 VDC. The controller's set points are fully adjustable to allow use with virtually any battery type, chemistry, and charging profile.

Maximum PV Array				
Battery bank voltage	12 VDC	12 VDC	24 VDC	48 VDC
Max. PV array	FM 60	750 W	1,500 W	3,000 W
	FM 80	1,000 W	2,000 W	4,000 W

FLEXmax controllers come standard with a 4-line, 80-character backlit LCD screen that displays PV system performance with a 128 day history and is also used for programming and monitoring the system's operation. For larger systems, **OutBack's MATE series** of system controllers enables monitoring of up to 8 FM controllers from up to 300 feet away. The MATE also includes an opto-isolated RS-232 port for connection to a PC or laptop for data logging and system monitoring.

Both controllers have a programmable AUX relay that can be used for control functions such as battery enclosure fans, generator starting, or load control. The AUX output is 200 mA at 12 VDC. Use it to power a separate relay with a 12 VDC coil if you need to control more amperage or to control voltages (AC or DC) other than 12 VDC.

FLEXmax charge controllers are covered by a 5-year standard warranty and are Listed to UL 1741 and C22.2 No. 107.1.

NEW! FLEXmax Extreme MPPT Charge Controller

OutBack Power's sealed, outdoor-rated charge controller has improved thermal management capabilities and sealed construction designed for the most extreme environmental conditions. FLEXmax Extreme's advanced thermal engineering provides full power output from -20 to 45°C without requiring a cooling fan, and since a passively cooled unit can be sealed, circuit boards and other sensitive electronics can be fully protected from dust, dirt, insects, and other external sources of contamination, ensuring reliability and long-term operation. Fan-less operation is extremely quiet because there are no moving parts. An OutBack MATE is used for programming, or the easily-integrated AXS Card MODBUS/TCP interface (see page 98) provides command, control, and integration for industrial customers.

The **FLEXmax Extreme** can be used in negative, positive, or floating ground systems. It has ample wire-bending space and oversized terminals for easier installation with larger gauge wire, and mechanical design that permits servicing and replacing all power components while the unit is mounted on a wall and attached to conduit.

Output is rated at 80 A at 40°C (104°F), and the operating temperature range is -40°C to +60°C. The optional external **Extreme Turbo** fan is available to keep the controller cool in the most extreme conditions. It can be used with 12, 24, 36, 48, and 60 VDC battery systems and with PV arrays with voltage up to 150 VDC (open circuit). NEMA 3R rated. Listed to UL1741, IEC 62109 and IEC 62509. 5-year warranty.

OutBack MPPT Charge Controllers				
Model	Description	Dimensions (H" X W" x D")	Weight	Item code
FM80	OutBack 80 A MPPT charge control	16.25 x 5.75 x 4	12 lbs	**020-02020**
FM60	OutBack 60 A MPPT charge control	13.5 x 5.75 x 4	12 lbs	**020-02017**
Extreme	OutBack Extreme 80 A charge control	TBD		**020-02030**
Extreme Turbo	OutBack Extreme Turbo Fan			**020-02035**

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The **fate** of other charge controllers has just been **sealed**.

OutBack introduces the FLEXmax Extreme, a high performance fully-sealed outdoor-rated charge controller designed for extreme environmental conditions. The FLEXmax Extreme features multi-voltage Maximum Power Point Tracking (MPPT) technology, which increases the yield from a solar array by as much as 30% over conventional designs and **supports a wide variety of system designs** and energy applications. It's what you'd expect from OutBack, the inventor of multi-voltage MPPT technology and the industry's *de facto* standard.

The FLEXmax Extreme's advanced thermal engineering provides full power output from -20°C to 45°C without requiring a cooling fan. Additionally, the **unique sealed design protects sensitive electronics** from external sources of contamination.

- IP54/NEMA 3R environmentally-rated sealed enclosure
- Solid-state passively cooled design
- Integrated AXS Port Modbus/TCP Interface

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MidNite Solar

Classic MPPT Charge Controller

MidNite Classic charge controllers offer many useful features including Arc Fault Detection and Ground Fault Protection (GFP) which eliminate the need for a separate GFP breaker assembly.

Three sizes are available to accommodate solar arrays with operating voltages up to 150, 200, or 250 VDC. A feature called HyperVOC protects the controller from damage when open circuit voltage exceeds the operating voltage by a margin equal to the battery bank voltage. For example, the **Classic 150** will operate normally with up to 150 VDC of input but, when used with a 48 VDC battery bank operating at 50 VDC, will withstand up to 150 + 50 = 200 VDC. This allows you to maximize array size even when using higher voltage battery systems. The table below represents maximum power only; be sure to consult the power curves in the user's manual when sizing your PV array as allowable current varies with array voltage.

Maximum PV Array Size			
Battery bank voltage → (nominal)	12 VDC	24 VDC	48 VDC
Classic 150	1,200 W	2,350 W	4,300 W
Classic 200	1,000 W	1,950 W	3,800 W
Classic 250	750 W	1,550 W	2,750 W

MidNite Solar's Classic controllers have MPPT modes for solar, wind, or hydro with user adjustable power curves, and a learning mode for self-optimization. Classics can be stacked to act as one large controller without a separate HUB. They have two auxiliary outputs, a dry contact relay and a 12 VDC output. The Classic has built-in Ethernet and USB and RS-232 ports for two-way communication. An internal IP address enables the Classic to directly output operating data to the Internet or a local network without a central server. Each unit also has 32 MB of internal memory for data storage.

A built-in setup wizard covers battery bank size, string voltage, wind turbine selection, power and wire loss, PV breaker sizing and more. Firmware is user upgradeable using downloaded files. Each unit includes a sealing kit for dusty or salt-air environments, but sealing can reduce output by up to 20%.

Use MidNite 300VDC breakers (see Electric Distribution) for power source voltages over 150 VDC. Make sure that the breaker will fit into your DC power center, or use a separate MidNite Big Baby Box (see Electrical Distribution Parts) to accommodate the breaker. On the battery side of the controller, breakers need only be rated for the highest battery charge voltage.

The **Classic 150, 200 and 250** are Listed to UL 1741 and CAN/CSA C22.2 No. 107.1:2001/09/01 Ed: 3 (R2006) and are covered by a 5-year warranty. Dimensions are 15"H x 6"W x 4"D, and weight is 11.5 lbs for all units.

The **Classic Lite** version of each controller is a lower-cost option that omits the programmable user interface in favor of simple DIP switch programming.

The **MidNite Graphics Display Panel (MNGP)** is a remote LCD display that mimics the interface on the Classic charge controllers. It can also be used with the Lite versions of the Classic series.

The MidNite Clipper enables Classic charge controllers to work with wind or hydro turbines (see Converters & Controls for more information).

MidNite Solar Classic MPPT Charge Controllers					
Model	Maximum output current at battery voltage[1]			Item code	
	12 VDC	24 VDC	48 VDC	Full version	Lite version
Classic 150	96[2] A	94[2] A	86[2] A	**020-02405**	**020-02412**
Classic 200	79 A	78 A	76 A	**020-02407**	**020-02413**
Classic 250	61 A	62 A	55 A	**020-02409**	**020-02414**
Classic 250KS	40 A (120 VDC battery)			**020-02411**	**020-02415**
MNGP	MidNite Classic remote graphics display			**020-02422**	

[1]Maximum output current is reduced at higher array voltages. See manual for more detail.
[2]Output currents over 80 A require 110 A or 125 A breaker. Verify that there is sufficient space in the DC Power Center or breaker panel.

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Schneider Electric

Schneider Electric XW-MPPT60-150 Charge Controller

The **XW-MPPT60-150** can be used with PV arrays with voltages up to 150 VDC and can support an output of up to 60 A for battery voltages between 12 to 60 VDC. Maximum power point tracking (MPPT) maximizes energy harvest and provides increased flexibility in module selection and string sizing.

A large aluminum heat sink eliminates the need for an internal fan for added reliability. Built-in ground fault protection (GFP) eliminates the need for a separate GFP breaker. The XW-MPPT60-150 can be mounted on the side or top of the XW power distribution panel, or used stand-alone in other PV systems. The front panel features a 2-line 16-character display and 4 buttons for configuration and system monitoring. A battery temperature sensor is included with the controller.

The charge controller has a configurable single-function auxiliary output (producing 5 to 13 VDC at 200 mA) that can drive a relay for load control or activate devices, such as vent fans or indicator alarms. The XW-MPPT60-150 is able to communicate its settings and activity to other Xanbus-enabled devices, such as the XW Series inverter/charger, the **System Control Panel II (SCP), XW Automatic Generator Start (XW-AGS)**, and other XW-MPPT solar charge controllers through the Xanbus network.

The dimensions are 14"H x 5"W x 5"D, weight is 12 lbs. and it is covered by a 5-year warranty with an optional extension to 10-years. Listed to UL 1741 for the U.S. and Canada.

Schneider Electric XW-MPPT80-600 Charge Controller

The **XW-MPPT80-600** can accommodate open circuit voltages of up to 600 VDC, which reduces wiring needs, increases module selection and string sizing flexibility, and enables greater distance between the power source and battery bank. The MPPT PV array input window is 195 to 550 VDC, which supports an output of up to 80 A for 24 or 48 VDC battery banks. Standby power draw is less than 1 W.

The charge controller has a configurable single-function auxiliary output to drive a load control relay or to activate devices such as vent fans or indicator alarms. Full output current of 80A is available without de-rating in ambient temperatures up to 113°F (45ºC). Over-temperature protection de-rates the power throughput when ambient temperatures are higher. The XW-MPPT80-600 also features protections for input over/under voltage, output over current, and back-feed (reverse current). Built-in ground fault protection (GFP) eliminates the need for a separate GFP breaker. This unit is configurable for positive, negative, and ungrounded PV systems.

The XW-MPPT80-600 can be used with the XW power distribution panel, or stand-alone in other PV systems, with a Sq-D HU361RB 600 VDC array disconnect. For two strings, wire two poles of the disconnect into the controller terminals. Use a 100 A breaker on the battery side of the control.

A **battery temperature sensor** is included with the controller. The XW-MPPT80-600 is compatible with Xanbus-enabled devices, such as the XW Series inverter/charger, the System Control Panel, XW Automatic Generator Start Module, and other XW solar charge controllers through the Xanbus network. It can also be installed in a stand-alone mode with an XW System Control Panel.

XW-MPPT80-600 dimensions are 30"H x 8.63"W x 8.63"D, weight is 29.8 lbs. and it is covered by a 5-year warranty with an optional extension to 10-years. Listed to UL 1741 and CSA 107.1 for the U.S. and Canada.

Schneider Electric Xantrex XW Charge Controllers		
Model	**Description**	**Item code**
XW-MPPT60-150	XW 60 A 150 VDC MPPT charge control	**020-08040**
XW-MPPT80-600	XW 80 A 600 VDC MPPT charge control	**020-08048**
SQD HU361RB	PV Array disconnect switch for MPPT80-600 charge controller	**053-02312**
XW SCP	XW System Control Panel - provides central user interface for Xanbus network	**030-01181**
XW-AGS	XW Automatic Generator Start Module	**030-01183**

Morningstar

Morningstar TriStar MPPT Charge Controllers

Morningstar's **TriStar TS-MPPT-45** and **TS-MPPT-60** solar charge controllers with TrakStar Technology are advanced maximum power point tracking (MPPT) controllers for photovoltaic (PV) systems up to 3 kW. Applications include off-grid and grid-tied residential and commercial with battery-based inverters, telecommunications, 12 V RV & marine applications, traffic & highway telemetry, industrial automation & control and larger scale solar outdoor lighting. The TS-MPPT controllers can be used with arrays with a maximum open circuit voltage of 150 VDC and has a charging range between 8 and 72 VDC. A remote temperature sensor (RTS) is included.

With a peak efficiency of 99%, no fan, and multiple power stages, these controllers have less power loss compared to other MPPT controllers. The TriStar MPPT features a smart tracking algorithm that maximizes the energy harvest from the PV by rapidly finding the solar array peak power point with extremely fast sweeping of the entire I-V curve.

Optional local and remote meters provide detailed operating data, alarms and faults with three LED's to display system status. The TS-MPPT has a simple DIP Switch setup for plug and play operation or is fully programmable for custom and advanced programming with a PC connection. The chassis on the TriStar controllers is isolated from the power circuits, allowing use in both negative and positive grounded systems.

Extensive Networking and Communications Capabilities enables system monitoring, data logging, and remote adjustments. Both models offer open standard MODBUS protocol and Morningstar's MS View software and allow a Serial RS-232 connection to a PC or laptop. In addition, the TS-MPPT-60 includes a built-in Ethernet port for a fully web-enabled interface to view data from a web browser to display up to 200 days of data logging and send email/text and messages. The TS-MPPT-60 also has a built-in RS-485 port for connecting to an EIA-485 network. The **RSC-1 communications adapter** converts an RS-232 serial connector to a standard RS-485 port and may be used to include the TS-MPPT-45 and TriStar (PWM) controllers and Morningstar's Relay Driver in a EIA-485 Network. The TriStar MPPT can also be used as an EIA-485 network bridge for remote access to multiple devices through one Ethernet connection.

In addition to computer networking, Morningstar has developed the ability to set up a separate Meterbus network. The meter ports allow for communications between compatible products and Morningstar's **MeterHub (HUB-1)** allows multiple Morningstar products to communicate over an expanded Meterbus network to provide improved data monitoring, additional capabilities and lower system cost. It enables multiple controllers to share a single TriStar meter and display individual controller data as well as aggregated data for the entire system. The HUB-1 also enables multiple controllers to share a single **Relay Driver (RD-1)**.

Weight: 9.2 lbs. Dimensions: 11.4"H x 5.1"W x 5.6"D. 5-year warranty. ETL Listed to UL 1741.

Morningstar TriStar MPPT Charge Controllers						
Model	Description	Web enabled	Nominal maximum array power			Item code
			12 VDC	24 VDC	48 VDC	
TS-MPPT-45	TriStar MPPT 45 A charge controller	Yes*	600 W	1,200 W	2,400 W	**020-01109**
TS-MPPT-60	TriStar MPPT 60 A charge controller	Yes	800 W	1,600 W	3,200 W	**020-01110**
TS-M-2	TriStar Meter-2 Digital Display for TriStar controllers - mounts on front of charge controller					**020-01111**
TS-RM-2	TriStar Remote Meter-2 Display with 100' cable					**020-01112**
HUB-1	MeterHub controller communications HUB					**020-01260**
RTS	Temperature sensor (replacement – one RTS is included with the controller as standard equipment)					**020-01141**
RSC-1	Communications adapter RS-232 to EIA-485					**020-01256**
RD-1	Relay driver with 4 independent outputs for system control functions					**020-01255**

*with added option equiment.

Morningstar SunSaver MPPT 15A Charge Controller

The **SunSaver MPPT** (Maximum Power Point Tracking) charge controller is designed for 12 and 24 VDC battery charging from a PV array with a maximum open circuit voltage of 75 VDC. Use up to three 36-cell PV modules in series or a single 60-cell or 72-cell module to provide up to 200 W when charging a 12 VDC battery or up to 400 W when charging a 24 VDC battery. The SunSaver MPPT maximizes the output of the PV array by rapidly finding the array's peak power point with extremely fast sweeping of the entire I-V curve, providing an estimated 5-25% power boost over PWM or simple on-off controllers, especially during periods of colder temperatures and low battery voltages when it is most needed.

The controller features electronic protection from short circuit, overcurrent, reverse polarity, high temp, high voltage, lightning, and transient surges. An adjustable low-battery load disconnect protects the battery from over-discharge. LED indicators indicate charging, low-battery and faults. The optional meter provides detailed system information, 30 days of logged data, alarms, and faults. The SS-MPPT has a simple DIP Switch setup for plug and play operation or is fully programmable for custom and advanced programming with a PC connection using the **PC MeterBus Adapter (MSC)** and Morningstar's **MSView** software (available for free on Morningstar's website). Also compatible with Morningstar's **MeterHub** (see previous page).

The SunSaver MPPT now features programmable lighting control for up to 4 time periods and is adjustable with respect to hours/minutes after/before – Dusk/Dawn/Solar Midnight/Solar Noon. Mounts on DIN rail with DIN-1 rail clip. SS-15MPPT dimensions are 6.6"H x 2.75"W x 2.2"D, weight is 1.65 lbs, and it is covered by a 5-year warranty. Listed to UL 1741 CSA 107.1 for U.S. and Canada.

Morningstar SunSaver MPPT Charge Controllers				
Model	**Description**	**DC system voltage**	**Charge current**	**Item code**
SS-15MPPT	SunSaver MPPT charge controller	12 or 24 VDC	15 A	**020-01261**
RM-1	SunSaver MPPT remote meter			**020-01258**
RTS	Battery temperature sensor			**020-01141**
MSC	Meterbus adapter			**020-01257**
DIN-1	Din rail clip - each			**020-01259**

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Look to Morningstar's Patented TrakStar™ MPPT Algorithm Technology To Deliver the Industry's Best-in-Class Peak Solar Array Efficiency Rating:
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• Sweep the Full Array Faster & More Often than the Competition.
• Optimize Overall Battery Health.
• Maximize Power Levels & Provide Excellent Solar Array Performance (by recognizing multiple power points) during Shading or Mixed Solar Arrays.
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Blue Sky Energy

Solar Boost Charge Controllers

The **Blue Sky Solar Boost** charge controllers feature Maximum Power Point Tracking (MPPT), selectable charge voltage set points for flooded, AGM, and gel lead-acid batteries and an equalize function to periodically condition liquid electrolyte lead-acid batteries. An optional user-friendly digital display is available to monitor PV charge performance. The display shows battery voltage, solar current, charge current, and charge mode, either in the controller, as a remote panel installed up to 300 feet away, or both. Optional temperature compensation of charge voltage is also available to further improve charge controller and battery performance. Solar Boost controllers are available with or without the digital display and optional remote display. Reverse-polarity protection. 5-year limited warranty.

Blue Sky Energy Solar Boost 50L

The **SB50L** charge controller can be used with 12 and 24 VDC battery systems. It can also be used to charge a 12 VDC battery from a 24 VDC array. Maximum open-circuit PV array voltage is 57 VDC. Dimensions: 10"H x 8.75"W x 3.5"D. ETL Listed to UL1741 and CSA E332-1/2 for the U.S. and Canada.

Blue Sky Energy Solar Boost 3048L

SB3048L is designed to charge 24 and 48 VDC battery systems from a 48 to 60 VDC array (maximum open-circuit voltage is 140 VDC). Maximum charge current is 30 A output at 24 or 48 VDC. Dimensions: 10"H x 8.75"W x 3.5"D. ETL Listed to UL1741 and CSA E332-1/2 for the U.S. and Canada.

Blue Sky Energy Solar Boost 3024iL

The **SB3024iL** is designed to charge 12 and 24 DC battery systems from a 24 VDC array (maximum open circuit voltage is 57 VDC). Maximum charge current is 40A output at 12 VDC and 30 A at 24 VDC. It has an auxiliary output that can serve as a 20 A load controller or as a 2 A battery charger.

The **SB3024DiL** version converts the 20 A auxiliary output into a separate 20 A diversion type charge controller for hydroelectric, wind, or similar generator type power sources. The Diversion Control upgrade also allows the 3024 to divert full available PV and generator power which is not required for battery charging to a useful purpose such as heating water.

The SB3024iL and SB3024DiL are both **IPN network interface** enabled (see next page for details), and include load control outputs so they can also serve as lighting controllers. An IPN Pro-Remote is required to enable and configure dusk-to-dawn lighting control. Listed to UL 1741 and CSA STD E335-1/2E.

Blue Sky Energy Solar Boost Charge Controllers				
Model	**Description**	**System voltage**	**Charge current**	**Item code**
SB50L	Charge controller	12 / 24 VDC	50 A	**020-03140**
SB50DL	Controller with digital display	12 / 24 VDC	50 A	**020-03137**
SB50PDL	Front cover with digital display for SB50L			**020-03134**
SB3048L	Charge controller	24 / 48 VDC	30 A	**020-03128**
SB3048DL	Controller with digital display	24 / 48 VDC	30 A	**020-03125**
SB3048PDL	Front cover with digital display for SB3048L			**020-03131**
SB3024iL	Charge controller	12 / 24 VDC	40 / 30 A	**020-03158**
SB3024DiL	Controller with digital display	12 / 24 VDC	40 / 30 A	**020-03159**
SB3024PDiL	Front cover with digital display for SB3024i			**020-03157**
SB50RD25	Remote digital display with 25' cable – for SB50 and SB3048 and SB6024			**020-03152**
930-0022-20	Battery temperature sensor			**020-03149**

Blue Sky Energy IPN Controllers

Blue Sky Energy's Integrated Power Net™ , or IPN Network provides an integrated charge controller communication strategy. The advanced high speed digital network allows up to 8 IPN capable charge controllers to communicate with each other and operate as a single machine rather than separate charge controllers. The IPN Network also allows networked controllers to share an optional battery temperature sensor and remote display. The IPN Network does not require an additional controller, display, or other special communication hardware or software to operate.

The **Solar Boost 3024iL, 2512iX, and 1524iX** charge controllers include load control outputs so they can also serve as lighting controllers. An **IPN Pro-Remote** is required to enable and configure dusk-to-dawn lighting control but does not need to remain connected to the system and can be used as a setup tool only.

Blue Sky Energy Solar Boost 2512i and 2512iX, and 1524iX

The **SB 2512i** is a fully automatic 3-stage charge controller system. A partial IPN network interface allows use of the IPN-Remote or IPN Pro-Remote displays.

Additional features provided in the **Solar Boost 2512iX** and **1524iX** include automatic or manual equalization, battery temperature sensor input, full IPN network compatibility, and an auxiliary output. The user-configurable auxiliary output can serve as either a 25 A (15/20 in 1524iX) load controller or a 2 A auxiliary battery charger for a separate battery, such as the engine battery in an RV. The auxiliary output can also provide fully adjustable dusk to dawn lighting control. The new HV versions can charge a 12 VDC battery from a single 60-cell module.

Blue Sky Energy IPN Remotes and Optional Equipment

The **IPN Remote** display provides basic monitoring for IPN compatible charge controllers. The unit displays battery voltage, output current and charge controller system status for up to 8 controllers on a single IPN network. An LED display is used to provide readability in any lighting. The charge status indicator displays system status and battery state-of-charge. When the battery is being charged, the display toggles between battery voltage and charge controller output current. The current display can be configured to show the total output current from all controllers on the IPN network, or the output current from a particular controller. Multiple IPN-Remote displays can be placed on a single IPN network even if an IPN-ProRemote is already present.

The **IPN-ProRemote** combines charge controller monitoring and battery system monitoring in a single remote display, eliminating the need for a separate battery monitor. A high-accuracy calculation of remaining battery capacity compensates for a variety of factors, including charge/discharge current, battery size, type, and temperature. Information learned from past battery behavior is used to continuously improve metering accuracy. The IPN-ProRemote also monitors and controls Blue Sky's IPN-based charge controllers. It can monitor both the combined total and individual status of up to 8 IPN charge controllers on a single IPN network.

The **UCM Universal Communications Module** acts as a bridge between Blue Sky's IPN Network and external systems. A standard MODBUS RTU interface is provided both as isolated RS-485 and TCP\IP Ethernet based MODBUS/IP and includes a built-in HTTP web server allowing data view and parameter setup with a standard web browser either locally or globally over the Internet without a subscription.

The **Battery Temperature Sensor** can be used with any Solar Boost controller. Optional shunts allow the remotes to monitor other charging sources and loads.

Blue Sky Energy IPN Charge/Lighting Controllers					
Model	**Description**	**DC system voltage**	**Charge current**	**2512-HV Item code**	**Item code**
SB2512i	Charge controller	12 VDC	25 A	**020-03164**	**020-03123**
SB2512iX	Charge controller	12 VDC	25 A	**020-03165**	**020-03124**
SB1524iX	Charge controller	12 or 24 VDC	20/15 A	**--**	**020-03118**
IPNPRO-S	IPN Pro-Remote display with 500 A shunt				**020-03161**
IPNPRO	IPN Pro-Remote display				**020-03162**
IPNREM	IPN Remote				**020-03163**
UCM	Universal Communication Module – IPN to RS-485/Ethernet connection module				**020-03166**
930-0022-20	Battery Temperature Sensor				**020-03149**
CS-100	Remote shunt 100 A / 100 mV				**028-09245**
CS-500	Remote shunt 500 A / 50 mV				**028-09253**

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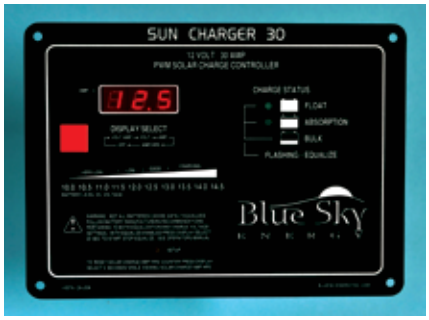

New Sun Charger 30 advanced 12V / 30 amp PWM solar charge controller with optional LVD

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QUALITY....RELIABILITY....BLUE SKY ENERGY, CHANGING THE WAY SOLAR IS USED EVERYDAY

Blue Sky Energy

Blue Sky Energy RV Charge Controllers

These panel-mount controllers are commonly used in RV and marine applications, but they can also be used for cabin systems or any small 12 VDC power system where a panel mounted controller and meter are desired.

Blue Sky Energy Solar Boost 2000E

This 25 A MPPT solar charge controller is for 12 VDC systems and has a maximum input V_{oc} of 30 VDC. A built-in LCD digital display monitors solar charge performance, and shows battery voltage, solar panel current and output charge current. You can actually see current boost working by knowing the difference between solar panel current and output charge current. A charge status LED indicates the present charge mode, and shows when the battery has become fully charged. The optional **Battery Temperature Sensor** increases charging accuracy.

This controller is very popular in RV installations. It mounts in a 5-11/16" x 3-15/16" cut-out and is wired from the rear. The optional wall-mount box allows for surface mounting.

NEW! Blue Sky Energy Sun Charger 30 PWM Charge Controller

Blue Sky Energy's new **Sun Charger 30 (SC30)** panel-mount solar charge controller will charge a 12 VDC battery bank at up to 30 A from a 12 VDC (nominal) PV array. It uses precise PWM charge voltage control (not MPPT) combined with a sophisticated 3-stage charge algorithm to optimally charge flooded, GEL, or AGM lead-acid batteries. All charge settings are user adjustable. To periodically condition flooded batteries, the Sun Charger 30 will also perform a manual or automatic equalization charge.

The SC30 controller is designed to work with 12 VDC nominal PV modules (36-cell), and cannot be used with 60-cell or 72-cell modules. Maximum PV open-circuit voltage at STC is 24.0 VDC. Maximum PV short-circuit current (amps) at STC is 27 A. Maximum PV power output of the array (STC) is 450 W.

The built-in low power LED digital display combines readability with very low power consumption, includes an automatic night time diming feature and may be turned off completely if desired. The high accuracy display shows battery voltage, and solar charge current, and computes total solar charge amp-hours produced.

Conformal coated electronics, anodized face plate and stainless steel fasteners resist corrosion. Built-in protection for reverse polarity, battery/PV swap, transient voltage, over current, over temperature. Operating temperature range is -40°C - +45C. Maximum battery cable and PV array input wire size is #8 AWG.

The dimensions of the Solar Boost Sun Charger 30 are 4 5/8"H x 6 3/8"W x 1 1/4"D. 5-year warranty.

Blue Sky Energy RV Charge Controllers				
Model	**Description**	**System voltage**	**Max charge current**	**Item code**
SB2000E	25 A MPPT Charge controller	12 VDC	25 A	**020-03122**
SC30	30 A PWM Panel mount charge controller	12 VDC	30 A	**020-03180**
720-0011-01	Wall mount box for SB2000E			**020-03119**
930-0022-20	Battery temperature sensor			**020-03149**

Morningstar

Morningstar SunSaver Duo RV Charge Controller

The **SunSaver Duo** 2-battery charge controller will charge two separate and isolated batteries at the same time, such as a 'house' battery and an engine battery in an RV or yacht. This controller also includes a backlit remote meter that may be flush or surface mounted, and displays alpha-numeric and graphical information about the solar power system status. Epoxy encapsulated electronics for environmental protection. User adjustable via DIP switch or connection to a personal computer. Optional **Remote Temperature Sensor** for battery bank. 5-year warranty.

Morningstar SunSaver Duo RV Charge Controller & Accessories				
Model	**Description**	**DC system voltage**	**Charge/load current**	**Item code**
SSD-25RM	SunSaver Duo with remote meter	12 VDC	25 A	**020-01250**
RTS	Remote temperature sensor			**020-01141**

Morningstar

Morningstar TriStar PWM Charge Controllers

The **TriStar** pulse width modulated (PWM) controllers can operate as solar charge controllers, load controllers, or diversion regulators in 12, 24 or 48 VDC systems. They can also be custom programed for 36 VDC. Two or more controllers can be used to provide multiple functions. PWM may be changed to on/off operation to prevent telecom noise.

Two models are available with current ratings of 45 A and 60 A. Seven different set points are selectable via DIP switches for plug and play operation. An RS-232 communications port enables PC or laptop connection to adjust controller set points, to download internally logged data, or to configure detailed PC data logging. A PC can communicate with the TriStar with open standard MODBUS protocol and Morningstar's MS View software. The **RSC-1 communications adapter** can be used to convert the RS-232 serial connector to EIA-485 to be included in an EIA-485 network.

The TriStar also has a lighting control feature with 7 DIP Switch presets or custom programmed settings with up to two ON-OFF time periods after/before dusk and dawn.

An optional **TriStar Meter-2 Digital Display** can be mounted on the front of the controller or up to 100 feet away using 4-conductor phone cable with RJ11 jacks. The meters can provide in depth system information including 60 days of internally logged data. They can also be connected to a MeterHub network with the **MeterHub (HUB-1)** to be displayed on a TriStar Meter or networked with a Relay Driver for relay switch operation.

Battery temperature compensation may be added with the optional **Remote Temperature Sensor (RTS)**. Dimensions: 10.25"H x 5"W x 2.8"D. Weight: 3.5 lbs. 5-year warranty. Listed to UL 1741 for U.S. and Canada.

Morningstar TriStar PWM Charge Controllers				
Model	**Description**	**DC system voltage**	**Charge current**	**Item code**
TS-45	TriStar 45 charge controller	12, 24, or 48 VDC	45 A	**020-01105**
TS-60	TriStar 60 charge controller	12, 24, or 48 VDC	60 A	**020-01108**
RTS	Battery temperature sensor			**020-01141**
TS-M-2	TriStar Meter-2 mounts on front of charge controller			**020-01111**
TS-RM-2	TriStar Remote Meter-2 display with 100' cable			**020-01112**

Morningstar ProStar PWM Charge Controllers

ProStar PWM charge controllers make maximum use of valuable PV power. They have automatic equalization and temperature compensation, and provide 4-stage charging including a monthly equalize charge. The ProStar controllers can be used on 12, 24, and 48 VDC systems with AGM, gel, and wet-cell lead-acid batteries. Front panel LEDs indicate charging status and state-of-charge. Reverse polarity protection on input and output prevents inadvertently damaging the controller. Short circuited loads are automatically disconnected.

M models include an LCD meter to display battery voltage, PV charging current, and load current. Low voltage disconnect (LVD) is current-compensated to prevent false disconnect when the battery is heavily loaded. Internal circuitry is conformal coated to guard against corrosion. ProStar dimensions are 6.01"H x 4.14"W x 2.2"D. 5-year warranty.

Morningstar Prostar PWM Charge Controllers				
Model	**Description**	**DC system voltage**	**Charge current**	**Item code**
PS-15	ProStar 15	12 or 24 VDC	15 A	**020-01120**
PS-15M	ProStar 15 with digital display	12 or 24 VDC	15 A	**020-01123**
PS-15M-48	ProStar 15 48 V with digital display	48 VDC	15 A	**020-01126**
PS-15M-48-PG	ProStar 15 48 V with digital display positive ground	48 VDC	15 A	**020-01129**
PS-30	ProStar 30	12 or 24 VDC	30 A	**020-01132**
PS-30M	ProStar 30 w/ digital display	12 or 24 VDC	30 A	**020-01135**
PS-30M-PG	ProStar 30 w/ digital display positive ground	12 or 24 VDC	30 A	**020-01138**
RTS	Remote temperature sensor			**020-01141**

Morningstar SunSaver Gen3 Charge Controllers

SunSaver Gen3 controllers are advanced PWM solar battery charging and load controllers for smaller stand-alone 12 and 24 VDC PV systems. A rugged anodized aluminum case, marine rated terminals, and epoxy encapsulated electronics enhance durability. A temperature compensation sensor in the charge controller varies full charge voltage with temperature.

SunSavers are field-selectable for sealed or flooded batteries and have a 4-stage battery charging process (including auto equalization for flooded batteries) optimized for long battery life and improved system performance. Self-diagnostics and electronic error protection prevent damage when installation mistakes or system faults occur and reset automatically when resolved. The Gen3 controllers include a multi-color status LED as well as 3 Battery LEDs, which together indicate system status, battery state-of-charge and 13 possible error conditions. The new terminal cover prevents contact with the wiring terminals. The load output connections can provide power to DC loads up to the unit's amperage rating, and "L" models provide low-voltage disconnect (LVD) for connected loads. Telecom mode and 15 V max charge limit for sensitive loads. Negative ground only. Operating temperature range of –40°C to +60°C.

SunSaver dimensions are 6"H x 2.2"W x 1.3"D. These Gen3 SunSaver Controllers are approved for Class 1 Div 2 for hazardous locations and are Listed to UL1741 for the U.S. and Canada. CSA C22.2 No. 107.1-01 certification. 5-year warranty.

Morningstar SunSaver Gen3 PWM Charge Controllers					
Model	**Description**	**DC system voltage**	**Charge current**	**LVD current**	**Item code**
SS-6-12V	SunSaver	12 VDC	6 A	NA	**020-01245**
SS-6L-12V	SunSaver with LVD	12 VDC	6 A	6 A	**020-01248**
SS-10-12V	SunSaver	12 VDC	10 A	NA	**020-01230**
SS-10L-12V	SunSaver with LVD	12 VDC	10 A	10 A	**020-01233**
SS-20L-12V	SunSaver with LVD	12 VDC	20 A	20 A	**020-01239**
SS-10L-24V	SunSaver with LVD	24 VDC	10 A	10 A	**020-01236**
SS-20L-24V	SunSaver with LVD	24 VDC	20 A	20 A	**020-01242**
DIN 1	DIN rail clip for mounting SunSaver and SunLight controllers on a DIN rail - each (two needed per controller)				**020-01259**

Morningstar SunLight Charge Controller with Lighting Control

The **SunLight** is a SunSaver Gen2 controller that includes a rotary switch which allows it to turn on the loads after dusk for 2, 4, 6, 8, or 10 hours. One option turns loads on at dusk then off and on again before dawn. In this configuration, you can choose the following settings (in hours): 3/off/1, 4/ off/2, or 6/off/2. "On" from dusk to dawn is also possible. A test button turns light(s) on for five minutes. 5-year warranty. Dimensions: 6.6"H x 2.2"W x 1.3"D.

Morningstar SunLight Charge/Lighting Controllers					
Model	**Description**	**DC system voltage**	**Charge current**	**LVD current**	**Item code**
SL-10-12V	SunLight with LVD	12 VDC	10 A	10 A	**020-01218**
SL-20-12V	SunLight with LVD	12 VDC	20 A	20 A	**020-01224**
SL-10-24V	SunLight with LVD	24 VDC	10 A	10 A	**020-01221**
SL-20-24V	SunLight with LVD	24 VDC	20 A	20 A	**020-01227**

Morningstar SunGuard Charge Controller

The **SunGuard** uses the same charging circuit as the SunSaver and works well as a 12 VDC, low-power controller for up to 75W of PV module(s). Since it is epoxy encapsulated, it can be used outdoors in harsh environments. The SunGuard's dimensions are 2.5"H x 2"W x 1.6"D with wire leads for connecting module and battery, and it is covered by a 5-year warranty.

Morningstar SunGuard Charge Controller				
Model	**Description**	**System voltage**	**Charge current**	**Item code**
SG-4	SunGuard	12 VDC	4.5 A	**020-01215**

Morningstar SunKeeper Charge Controller

Morningstar's **SunKeeper** solar controller provides a low cost regulated output directly from the solar module to maximize battery life in small solar power applications. The SunKeeper is epoxy encapsulated and rated for outdoor use. By mounting directly to the module junction box and wiring through the junction box knockout, the connection is weather-proof. This eliminates the need for an additional housing for the controller. It's designed to mount in a ½" knockout in a PV module junction box or other enclosure.

The SunKeeper is available in 6A or 12A versions for small 12 VDC systems, and provides PWM 3-stage charging. Includes temperature compensation at the controller or alternatively at the battery when used with the optional Remote Temperature Sensor. Able to charge a zero voltage battery. A bi-color LED indicates solar charging, regulation, normal nighttime operation, and any controller or system faults.

The SunKeeper has been designed with extremely efficient power electronics and is rated to 70°C so it can be mounted behind a PV module. The SunKeeper is also certified for use in Class 1, Division 2 hazardous locations, making it well-suited for solar powered oil/gas applications. 5-year warranty. Listed to UL 1604 and CSA 22.2.

Morningstar SunKeeper Charge Controllers				
Model	**Description**	**System voltage**	**Charge current**	**Item code**
SK-6	SunKeeper 6	12 VDC	6 A	**020-01252**
SK-12	SunKeeper 12	12 VDC	12 A	**020-01253**
RTS	Remote battery temperature sensor			**020-01141**

Atkinson

Atkinson Electronics Lighting Controllers

The fully waterproof **PVLC** series charge and lighting controllers can be used with 12 or 24 VDC systems and are well-suited for operating area lighting or signage. **MD**-designated controllers have a motion sensor to activate the light or load when motion is sensed. Controllers with and without motion detectors are available in 15 A and 40 A versions.

All controllers have low-voltage load disconnect (LVD) and temperature compensation and can be used with sealed or flooded batteries. Pulse action reduces sulfating.

Atkinson Lighting Controllers				
Model	**System voltage**	**PV and load current**	**Dimensions (L"x W"x D")**	**Item code**
PVLC-15	12 or 24 VDC	15 A	2 x 3 x 1.25	**020-05425**
PVLC-40	12 or 24 VDC	40 A	3.3 x 5.5 x 1.7	**020-05427**
PVLC-15MD	12 or 24 VDC	15 A	2 x 3 x 1.25	**020-05432**
PVLC-40MD	12 or 24 VDC	40 A	3.3 x 5.5 x 1.7	**020-05435**

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Schneider Electric

Schneider Electric C-35, C-40 and C-60 PWM Controllers

The **Schneider Electric C-35, C-40**, and **C-60** PWM (pulse width modulator) controllers can be used as either PV charge controllers, DC load controllers or DC diversion regulators in 12 and 24 VDC systems (the C-40 can also be used in 48 VDC systems). Two controllers can be used together to provide multiple functions.

As DC load controllers, they disconnect the load at a user-defined low voltage and reconnect at a higher voltage reconnect point. As diversion controllers, they send excess power to a diversion load (see Controls and Relays) to regulate hydroelectric or wind generators. The maximum current throughput is reduced by 25% when used in diversion mode.

All Schneider Electric C-Series charge controllers have field-adjustable bulk and float set points and perform automatic equalization every 30 days or whenever low-voltage disconnect (LVD) is reached. Equalization can be manually initiated with automatic shut-off. The optional Battery Temperature Sensor can be used to increase accuracy of the control algorithms. The optional LCD Digital Display shows battery voltage, array current and power, cumulative amp-hours, and a separately resettable "trip" amp-hour measurement. The digital display can be mounted on the front of the charge controller, or with a cable for remote mounting in a double-gang electrical box up to 100 feet away.

These controllers are Listed to UL 1741 and CSA 22.2 No 107.1-95 and covered by a 2-year warranty.

Schneider Electric C-Series PWM Charge Controllers				
Model	**Description**	**System voltage**	**Charge current**	**Item code**
C-35	Charge/Load/Diversion controller	12 or 24 VDC	35 A	**020-08004**
C-40	Charge/Load/Diversion controller	12, 24, or 48 VDC	40 A	**020-08005**
C-60	Charge/Load/Diversion controller	12 or 24 VDC	60 A	**020-08009**
BTS/15	Battery temperature sensor with 15' cable			**020-08025**
BTS/35	Battery temperature sensor with 35' cable			**020-08029**
CM	Digital display mounts on front of charge controller			**020-08016**
CM/R50	Remote display with 50' cable			**020-08019**
CM/R100	Remote display with 100' cable			**020-08017**

Schneider Electric C-12 Charge & Lighting Controller

The **C-12 controller** is PWM microprocessor-based and has a 12 A low-voltage disconnect (LVD) and an automatic lighting control, making it well-suited for small remote loads such as signs, cabins and bus shelters. The lighting control activates the light at dusk, has an adjustable duration timer for 2 to 8 hours of run time, and can be set to run until dawn. The LVD shuts off the load when the battery voltage falls below a user-defined set point.

Use one of the C-Series **Battery Temperature Sensors** for more accurate battery charging. For use in 12 VDC systems only. The C-12 can be mounted outdoors. Its dimensions are 6.5" x 4.3" x 1.5" and it is UL Listed and covered by a 2-year warranty.

Schneider Electric C-12 Charge/Lighting Controller				
Model	**Description**	**System voltage**	**Charge current**	**Item code**
C-12	Schneider C-12 Charge controller / Lighting controller	12 VDC	12 A	**020-08002**